Peer Review Panel Report

by E. John List, Ph.D., P.E.

The following charge was made to the Peer review Panel:

Summary of Charge

The Peer Review Panel will be convened to review the modeling exercise (including the hydrodynamics component, the sediment transport component, the PCB fate and transport component, and the bioaccumulation component) at a minimum of three intervals during the modeling process: model construction, calibration, and validation. The Peer Review Panel shall focus on the following general issues (more specific questions are identified below):

1. Do the modeling frameworks include the significant processes, and are the descriptions of those processes sufficiently accurate to represent the hydrodynamics, sediment transport, and the chemistry, fate and transport, and bioaccumulation of PCBs in the Housatonic River?

2. Are the available data sufficient for development of models of the hydrodynamics, sediment transport and the chemistry, fate and transport, and bioaccumulation of PCBs in the Housatonic River?

3. Are the processes in the final models calibrated/validated to the extent necessary for prediction of future conditions?

4. How sensitive are the models to uncertainties in the descriptions of the relevant processes?

Review Comments

This report is an attempt to respond specifically to the questions stated above. The conclusions presented are based upon a review of the documents provided to the Panel, and the responses prepared by EPA and GE to written questions submitted by the Panel.

According to EPA estimates, approximately 50 percent of the PCB in the river reach to be modeled is included in the flood plains, and somewhat surprisingly there has been no estimate yet made of the distribution of this mass of PCB along the river reach. In that some, or even all, of this PCB could well be mobilized in an extreme flood event, it would seem that any assessment of remediation strategies must include the fraction of PCB located in the flood plains. Any modeling exercise that does not include the potential for this floodplain PCB to be mobilized is not really addressing the complete issue. Further, since a primary mechanism for the mobilization of the flood plains, namely bank erosion and the channel meanders that result from such erosion, cannot be included in the primary fate and transport model (EFDC), it is difficult to see how the

modeling can address anything but the short term mobilization of PCB within the river channel and the flood plains under conditions where there is no bank erosion. It is clear from the measurements of PCB in the sediments that if bank erosion occurs it will be a significant source of PCB to the river.

In this regard, this reviewer has a fundamental difficulty in responding to the questions posed to the Review Panel. It is the opinion of the reviewer, based upon the responses that have been offered to the Panel questions, that there is no measurable degree of certainty that there will be a successful outcome to the modeling project. The primary issues that concern the reviewer are the following:

1. This is the first time that the models proposed for use in the analysis have ever been used in such a coordinated fashion, where the outcome of one model is used as input to the next and so forth. In general, this would not be of great concern if the individual models themselves were completely proven in their own applications. However, this is not the case here. The primary model that will be used for the fate and transport, the Engineering Fluid Dynamics Code (EFDC) has never before been used in such a complex flow modeling situation and there are a significant number of unresolved issues with respect to its use. These include:

    a. The computational feasibility of the application of the model to a sinuous meandering channel that includes a significant flood plain area has not been previously demonstrated. In particular, the ability of the model to successfully predict flood plain erosion and deposition appears to be yet demonstrated.

    b. There are a very large number of modifications that are being made to the EFDC model specifically for the Housatonic river application. These modifications have yet to be proven:

        i. Wetting and drying routines for flow over the flood plains.

        ii. Changes in the grid nesting scheme to handle the river meanders.

        iii. Changes in the handling of bed load sediments with the addition of three new schemes and the ability of these schemes to model flood plain surface erosion and deposition during major stream flow events.

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        iv. Modification of the sediment erosion characteristics.

        v. Incorporation of an active layer bed thickness.

        vi. Incorporation of a variable time-stepping approach to the modeling.

c. Despite claims of widespread application of the EFDC model there are only two reports referenced that show application to fixed-boundary rivers, and two peer reviewed publications where the EFDC model has been applied to lakes. There are apparently no publications showing confirmed erosion and deposition predictions.

d. As noted above, EPA recognizes that bank erosion and the associated sediment loading could be a significant source of solids and PCB to the river, but that it is impossible for EFDC to predict either bank erosion or channel meanders that result from such erosion. EFDC has never been applied for analyses of bank erosion and the modeling specifically does not include any such bank erosion. However, as noted above, EPA's own assessment shows that almost half of the PCB is in the floodplains that make up the banks of the stream.

2. EPA believes that the river bottom, comprising over 98% of the wetted area of the river, is the dominant source of the total sediment load that is generated instream. This may well be true for the normal range of in-channel river flows. However, sediment measurements in a large number of streams during extreme flood flows have shown that it is these extreme events that lead to the dominant sediment loads and erosion. The scale of sediment loading increases very substantially as the flow rate increases, such that the sediment loads can become truly enormous during major flooding events. It is these events that will control the long term fate of the PCB in the sediments. It is very difficult to see how the models proposed for use by EPA can accomplish predictions of attenuation if the major events that result in transport of the PCB have never been previously modeled successfully. EPA's response to this question (listed as No. 47 in their response to Peer Review Panelist Questions) appears to miss this point and fails to address the issue.

In summary, the modeling proposed by EPA may well provide a reasonable assessment of the short term fate of PCB within the river channel, but given the fraction of PCB that exists within the river bank sediments there is no measure of certainty that the modeling will successfully reproduce the long term fate of almost half the PCB located within the river reach.